

WHAT IS CLAIMED IS:

1. A trocar system comprising:

an elongated probe including a first central axis and a tip end for forming a punctured hole in a living  
5 tissue;

10 a cylindrical sheath including tip and base ends, second central axis and a through hole extending along the second central axis between the tip and base ends, the sheath being adapted so that the tip end of the probe projects from the tip end of the sheath, when the probe is inserted in the through hole of the sheath so as to align the first central axis with the second central axis;

15 a cylindrical dilator including tip and base ends, a third central axis, a through hole extending along the third central axis between the tip and base ends, and a punctured hole dilating portion to dilate the punctured hole formed in the living tissue by the tip end of the probe in the tip end of the dilator, the dilator being adapted so that the tip end of the sheath projects from the tip end of the dilator, when the sheath is inserted in the through hole of the dilator so as to align the second central axis with the third central axis;

20 25 a cylindrical trocar including tip and base ends, a fourth central axis and a through hole extending along the fourth central axis between the tip and base

ends, the trocar being adapted so that the tip end of the dilator projects from the tip end of the trocar, when the dilator is inserted in the through hole of the trocar so as to align the third central axis with the 5 fourth central axis, the probe, sheath and dilator being removed from the through hole of the trocar to retain the trocar in a patient's body wall, after guiding the trocar between the tip and base ends into the punctured hole;

10 an engaging mechanism to detachably engage the dilator with the trocar in a state in which the dilator is inserted in the trocar; and

15 a hold portion by which the base ends of the trocar and the dilator are connected and integrated with each other in a state in which the trocar is engaged with the dilator by the engaging mechanism.

2. The trocar system according to claim 1, wherein the hold portion includes:

20 an enlarged diameter portion which is disposed on the base end of the dilator and has an outer diameter is enlarged with the tip end of the dilator; and

25 a bulging portion disposed on the base end of the trocar and formed of at least a part of the base end of the trocar projected in a direction deviating from the axial direction of the trocar toward an apart side from a side in the vicinity of the tip end of the trocar.

3. The trocar system according to claim 2,

wherein the enlarged diameter portion includes a concave portion in which at least a portion of the base end of the trocar on a side apart from the tip end of the trocar is to be fitted on a side in the vicinity of 5 the tip end of the dilator.

4. The trocar system according to claim 3, wherein the enlarged diameter portion includes a small diameter portion to be held by the operator's finger, and a large diameter portion having a diameter enlarged 10 toward the tip end of the dilator as compared with the small diameter portion and the concave portion formed therein.

5. The trocar system according to claim 4, wherein the bulging portion has a conical shape having 15 a small diameter on the side in the vicinity of the tip end of the trocar and whose diameter is enlarged apart from the tip end of the trocar.

6. The trocar system according to claim 5, wherein the probe includes an ultrasonic transducer 20 provided on the base end, which is formed so as to be capable of transmitting an ultrasonic vibration and which is capable of oscillating the ultrasonic vibration toward the tip end of the probe.

7. The trocar system according to claim 6, 25 wherein the tip end of the probe has a conical shape and has a surface cut at an acute cut angle with respect to the axial direction of the probe.

8. The trocar system according to claim 7,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over  
a vertical angle of the tip end of the probe.

5 9. The trocar system according to claim 3,  
wherein the enlarged diameter portion includes a  
spherical portion to be held by an operator's hand and  
the spherical portion includes the concave portion  
inside.

10 10. The trocar system according to claim 9,  
wherein the bulging portion has a conical shape having  
a small diameter on the side in the vicinity of the tip  
end of the trocar and whose diameter is enlarged apart  
from the tip end of the trocar.

15 11. The trocar system according to claim 10,  
wherein the probe includes an ultrasonic transducer  
provided on the base end, which is formed so as to be  
capable of transmitting an ultrasonic vibration and  
which is capable of oscillating the ultrasonic  
vibration toward the tip end of the probe.

20 12. The trocar system according to claim 11,  
wherein the tip end of the probe has a conical shape  
and has a surface cut at an acute cut angle with  
respect to the axial direction of the probe.

25 13. The trocar system according to claim 12,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over

a vertical angle of the tip end of the probe.

14. The trocar system according to claim 3,  
wherein the enlarged diameter portion includes a  
columnar portion to be held by an operator's hand and  
5 the columnar portion includes the concave portion  
inside.

15. The trocar system according to claim 14,  
wherein the bulging portion has a conical shape having  
a small diameter on the side in the vicinity of the tip  
10 end of the trocar and whose diameter is enlarged apart  
from the tip end of the trocar.

16. The trocar system according to claim 15,  
wherein the probe includes an ultrasonic transducer  
provided on the base end, which is formed so as to be  
15 capable of transmitting an ultrasonic vibration and  
which is capable of oscillating the ultrasonic  
vibration toward the tip end of the probe.

17. The trocar system according to claim 16,  
wherein the tip end of the probe has a conical shape  
20 and has a surface cut at an acute cut angle with  
respect to the axial direction of the probe.

18. The trocar system according to claim 17,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over  
25 a vertical angle of the tip end of the probe.

19. The trocar system according to claim 3,  
wherein the bulging portion has a conical shape having

a small diameter on the side in the vicinity of the tip end of the trocar and whose diameter is enlarged apart from the tip end of the trocar.

20. The trocar system according to claim 19,  
5 wherein the probe includes an ultrasonic transducer provided on the base end, which is formed so as to be capable of transmitting an ultrasonic vibration and which is capable of oscillating the ultrasonic vibration toward the tip end of the probe.

10 21. The trocar system according to claim 20, wherein the tip end of the probe has a conical shape and has a surface cut at an acute cut angle with respect to the axial direction of the probe.

15 22. The trocar system according to claim 21, wherein the cut angle is 60 degrees or less with respect to the axial direction of the probe and is over a vertical angle of the tip end of the probe.

20 23. The trocar system according to claim 1, wherein the hold portion includes at least one slip stopper which prevents the hold portion from slipping from the operator's hand.

25 24. The trocar system according to claim 1, wherein the probe includes an ultrasonic transducer provided on the base end, which is formed so as to be capable of transmitting an ultrasonic vibration and which is capable of oscillating the ultrasonic vibration toward the tip end of the probe.

25. The trocar system according to claim 24,  
wherein the tip end of the probe has a conical shape  
and has a surface cut at an acute cut angle with  
respect to the axial direction of the probe.

5 26. The trocar system according to claim 25,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over  
a vertical angle of the tip end of the probe.

10 27. The trocar system according to claim 1,  
wherein the tip end of the probe has a conical shape  
and has a surface cut at an acute cut angle with  
respect to the axial direction of the probe.

15 28. The trocar system according to claim 27,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over  
a vertical angle of the tip end of the probe.

29. A trocar system comprising:  
an elongated probe which includes a first central  
axis and a tip end for forming a punctured hole in a  
20 living tissue;

25 a cylindrical sheath including tip and base ends,  
a second central axis and a through hole extending  
along the second central axis between the tip and base  
ends, the sheath being adapted so that the tip end of  
the probe projects from the tip end of the sheath, when  
the probe is inserted in the through hole of the sheath  
so as to align the first central axis with the second

central axis;

5 a cylindrical sheath insertion portion including tip and base ends, a third central axis, a through hole extending along the third central axis between the tip and base ends, and a punctured hole dilating portion to dilate the punctured hole formed in the living tissue by the tip end of the probe in the tip end of the sheath insertion portion, the sheath insertion portion being adapted so that the tip end of the sheath 10 projects from the tip end of the sheath insertion portion, when the sheath is inserted in the through hole of the sheath insertion portion so as to align the second central axis with the third central axis;

15 a cylindrical dilator insertion portion which including tip and base ends, a fourth central axis, and a through hole extending along the fourth central axis between the tip and base ends, the dilator insertion portion being adapted so that the tip end of the sheath insertion portion projects from the tip end of the dilator insertion portion, when the sheath insertion 20 portion is inserted in the through hole of the dilator insertion portion so as to align the third central axis with the fourth central axis, the probe, sheath and sheath insertion portion being removed from the through 25 hole of the dilator insertion portion to retain the dilator insertion portion in a patient's body wall, after guiding the dilator insertion portion between the

tip and base ends into the punctured hole;

a dilator hold portion which is disposed on the base end of the sheath insertion portion so as to be held by the operator in a state in which the sheath insertion portion is inserted in the dilator insertion portion and has an outer diameter enlarged with respect to the tip end of the sheath insertion portion; and

5 a trocar hold portion which is disposed on the base end of the dilator insertion portion so as to be held by the operator in a state in which the sheath insertion portion is inserted in the dilator insertion portion, and has a portion on a side in the vicinity of the tip end of the dilator insertion portion bulges in a direction deviating from the axis of the dilator insertion portion, and a portion on at least a side apart from the tip end of the dilator insertion portion is held by the dilator hold portion in a state in which the sheath insertion portion is inserted in the dilator insertion portion.

10 20 30. The trocar system according to claim 29, wherein the dilator hold portion includes an enlarged diameter portion whose diameter is enlarged with respect to the tip end of the sheath insertion portion, and

15 25 the trocar hold portion includes a bulging portion which is projected in a direction deviating from the axial direction of the dilator insertion portion toward

a side of the trocar hold portion apart from the tip  
end of the dilator insertion portion from a side in the  
vicinity of the tip end of the dilator insertion  
portion and at least a part of which is covered with  
5 the dilator hold portion in a state in which the sheath  
insertion portion is inserted in the dilator insertion  
portion.

31. The trocar system according to claim 30,  
wherein the enlarged diameter portion includes a small  
10 diameter portion to be held by the operator's finger,  
and a large diameter portion whose diameter is enlarged  
toward the tip end of the sheath insertion portion as  
compared with the small diameter portion and the  
concave portion formed therein.

15 32. The trocar system according to claim 31,  
wherein the bulging portion has a conical shape having  
a small diameter on the side in the vicinity of the tip  
end of the dilator insertion portion and whose diameter  
is enlarged apart from the tip end of the dilator  
20 insertion portion.

25 33. The trocar system according to claim 32,  
wherein the probe includes an ultrasonic transducer  
provided on the base end, which is formed so as to be  
capable of transmitting an ultrasonic vibration and  
which is capable of oscillating the ultrasonic  
vibration toward the tip end of the probe.

34. The trocar system according to claim 33,

wherein the tip end of the probe has a conical shape and has a surface cut at an acute cut angle with respect to the axial direction of the probe.

35. The trocar system according to claim 34,  
5 wherein the cut angle is 60 degrees or less with respect to the axial direction of the probe and is over a vertical angle of the tip end of the probe.

36. The trocar system according to claim 30,  
10 wherein the enlarged diameter portion includes a spherical portion to be held by an operator's hand and the spherical portion includes the concave portion inside.

37. The trocar system according to claim 36,  
15 wherein the bulging portion has a conical shape having a small diameter on the side in the vicinity of the tip end of the dilator insertion portion and whose diameter is enlarged apart from the tip end of the dilator insertion portion.

38. The trocar system according to claim 37,  
20 wherein the probe includes an ultrasonic transducer provided on the base end, which is formed so as to be capable of transmitting an ultrasonic vibration and which is capable of oscillating the ultrasonic vibration toward the tip end of the probe.

25 39. The trocar system according to claim 38,  
wherein the tip end of the probe has a conical shape and has a surface cut at an acute cut angle with

respect to the axial direction of the probe.

40. The trocar system according to claim 39,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over  
5 a vertical angle of the tip end of the probe.

41. The trocar system according to claim 30,  
wherein the enlarged diameter portion includes a  
columnar portion to be held by an operator's hand and  
the columnar portion includes the concave portion  
10 inside.

42. The trocar system according to claim 41,  
wherein the bulging portion has a conical shape having  
a small diameter on the side in the vicinity of the tip  
end of the dilator insertion portion and whose diameter  
15 is enlarged apart from the tip end of the dilator  
insertion portion.

43. The trocar system according to claim 42,  
wherein the probe includes an ultrasonic transducer  
provided on the base end, which is formed so as to be  
20 capable of transmitting an ultrasonic vibration and  
which is capable of oscillating the ultrasonic  
vibration toward the tip end of the probe.

44. The trocar system according to claim 43,  
wherein the tip end of the probe has a conical shape  
25 and has a surface cut at an acute cut angle with  
respect to the axial direction of the probe.

45. The trocar system according to claim 44,

wherein the cut angle is 60 degrees or less with respect to the axial direction of the probe and is over a vertical angle of the tip end of the probe.

46. The trocar system according to claim 30,  
5 wherein the bulging portion has a conical shape having a small diameter on the side in the vicinity of the tip end of the dilator insertion portion and whose diameter is enlarged apart from the tip end of the dilator insertion portion.

10 47. The trocar system according to claim 46,  
wherein the probe includes an ultrasonic transducer provided on the base end, which is formed so as to be capable of transmitting an ultrasonic vibration and which is capable of oscillating the ultrasonic 15 vibration toward the tip end of the probe.

48. The trocar system according to claim 47,  
wherein the tip end of the probe has a conical shape and has a surface cut at an acute cut angle with respect to the axial direction of the probe.

20 49. The trocar system according to claim 48,  
wherein the cut angle is 60 degrees or less with respect to the axial direction of the probe and is over a vertical angle of the tip end of the probe.

25 50. The trocar system according to claim 29,  
wherein the hold portion includes at least one slip stopper which prevents the hold portion from slipping from the operator's hand.

51. The trocar system according to claim 29,  
wherein the probe includes an ultrasonic transducer  
provided on the base end, which is formed so as to be  
capable of transmitting an ultrasonic vibration and  
5 which is capable of oscillating the ultrasonic  
vibration toward the tip end of the probe.

10 52. The trocar system according to claim 51,  
wherein the tip end of the probe has a conical shape  
and has a surface cut at an acute cut angle with  
respect to the axial direction of the probe.

15 53. The trocar system according to claim 52,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over  
a vertical angle of the tip end of the probe.

54. The trocar system according to claim 29,  
wherein the tip end of the probe has a conical shape  
and has a surface cut at an acute cut angle with  
respect to the axial direction of the probe.

20 55. The trocar system according to claim 54,  
wherein the cut angle is 60 degrees or less with  
respect to the axial direction of the probe and is over  
a vertical angle of the tip end of the probe.